DE PRINCIPIIS NATURAE

by
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translated as
THE PRINCIPLES OF NATURE
TO BROTHER SYLVESTER
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1. Since some things can be, although they are not, and some things now are; those which can be and are not are said to be potency, but those which already exist are said to be in act. But existence is twofold: one is essential existence or the **substantial** existence of a thing, for example man exists, and this is existence *simpliciter*. The other is **accidental** existence, for example man is white, and this is existence *secundum quid*.

2. Moreover, for each existence there is something in potency. Something is in potency to be man, as sperm or the ovum, and something is in potency to be white, as man. Both that which is in potency to substantial existence and that which is in potency to accidental existence can be called **matter**: for example sperm is the matter of man and man is the matter of whiteness.

3. But these differ, because that which is in potency to substantial existence is called the **matter from which**, but that which is in potency to accidental existence is called the **matter in which**. Again, properly speaking, that which is in potency to substantial existence is called **prime matter**, but that which is in potency to accidental existence is called the *subject*. Thus we say that accidents are in a subject; but we do not say that the substantial form is in a subject.

4. In this way matter differs from subject because the subject is that which does not have existence by reason of something which comes to it, rather it has **complete** existence of itself (*per se*); just as man does not have existence through whiteness. But matter has existence by reason of what comes to it because, of itself, it has **incomplete** existence. Hence, simply speaking, the form

gives existence to matter; the accident, however, does not give existence to the subject, rather the subject gives existence to the accident; although sometimes the one is used for the other, namely matter for subject and conversely.

5. But, just as everything which is in potency can be called matter, so also everything from which something has existence whether that existence be substantial or accidental, can be called form; for example man, since he is white in potency, becomes actually white through whiteness, and sperm, since it is man in potency, becomes actually man through the soul. Also, because form causes existence in act, we say that the form is the act. However, that which causes substantial existence in act is called **substantial form** and that which causes accidental existence in act is called **accidental form**.

6. Because generation is a motion to form, there is a twofold generation corresponding to this twofold form. Generation *simpliciter* corresponds to the substantial form and generation *secundum quid* corresponds to the accidental form. When a substantial form is introduced we say that something comes into being *simpliciter*, for example we say that man comes into being or man is generated **[something]**. But when an accidental form is introduced, we do not say that something comes into being *simpliciter*, but that it comes into being as this; for example when man comes into being as white, we do not say *simpliciter* that man comes into being or is generated, but that he comes into being or is generated as white **[somehow]**.

7. There is a twofold corruption opposed to this twofold generation: *simpliciter* and *secundum quid*. Generation and corruption *simpliciter* are only in the genus of substance, but generation and corruption *secundum quid* are in all the other genera. Also, because generation is a change from non-existence to existence, contrarily, corruption should be from existence to non-existence. However, generation does not take place from just any non-being, but from the non-being which is being in potency; for example a statue comes to be from bronze which is a statue in potency and not in act.

8. In order that there be generation three things are required: **being in potency** which is matter, **non-existence in act** which is privation, and **that through which something comes to be in act** which is form. For example when a statue made from bronze the bronze which is in potency to the form of the statue is the **matter**; the shapeless or undisposed something is the **privation**; and the shape because of which is called a statue is the **form**. But it is not a substantial form because the bronze, before it receives the shape, has existence in act and its existence does not depend upon that shape; rather it is an accidental form, because all artificial forms are accidental. Art operates only on that which is already constituted in existence by nature.

9. Therefore there are three principles of nature: matter, form and privation. One of these, form, is that by reason of which generation takes place; the other two are found on the part of that from which there is generation. Hence matter and privation are the same in subject but they differ in definition, because bronze and what is shapeless are the same before the advent of the form; but for one reason it is called bronze and for another reason it is called shapeless. Wherefore, **privation** is not said to be a *per se* principle, but rather a *per accidens* principle; because it is coincident with matter. For example we say that it is *per accidens* that the doctor builds, because he does not do this in so far as he is a doctor but in so far as he is a builder, which is coincident with being a doctor in the same subject.

10. But there are two kinds of accidents: the necessary, which is not separated from the thing, for example risible in man; and the non-necessary, which can be separated, for example white from man. Thus, although privation is a *per accidens* principle, still it does not follow that it is not necessary for generation, because matter is never entirely without privation. For in so far as it is under one form it has the privation of another and conversely, just as there is the privation of fire in air and the privation of air in fire.

11. Also, we should note that, although generation is from non-existence, we do not say that negation is the principle but that privation is the principle, because negation does not determine a subject. **Non-seeing** can be said even of non-beings, for example we say that the dragon does not see and we say the same of beings which are not apt to have sight, as stones. But privation is said only of a determined subject in which the habitus is apt to come to be; for example blindness is said only of those things which are apt to see. Also, because generation does not come to be from non-being *simpliciter*, but from the non-being which is in some subject, and not in just any subject, but in a determined subject, because fire does not come to be from just any non-fire, but from such non-fire as is apt to receive the form of fire; therefore we say that privation is the principle, and not negation.

12. Privation differs from the other principles, because the others are principles both in existence and in becoming For in order that a statue come to be, it is necessary that there be bronze and, further, that there be the shape of the statue. Again, when the statue already exists, it is necessary that these two exist. But privation is a principle in **becoming** and not in existing, because until the statue comes to be it is necessary that it not be a statue. For, if it were, it would not come to be, because whatever comes to be is not, except in successive things, for example in time and motion. But from the fact that the statue already

exists, the privation of statue is not there, because affirmation and negation are not found together, and neither are privation and habitus. Likewise, privation is a *per accidens* principle, as was explained above, but the other two are *per se* principles.

13. Therefore, from what was said, it is plain that **matter** differs from form and from privation by definition. Matter is that in which the form and privation are understood, just as in bronze the form and that which is shapeless is understood. Still, "matter" sometimes designates privation and sometimes does not designate privation. For example, when bronze becomes the matter of the statue, it does not imply a privation because when I speak of bronze in this way I do not mean what is undisposed or shapeless. Flour, on the other hand, since it is the matter with respect to bread, implies in itself the privation of the form of bread, because when I say "flour" the lack of disposition or the inordination opposed to the form of bread is signified. Also, because in generation the matter or the subject remains, but the privation does not, nor does the composite of matter and privation; therefore that matter which does not imply privation is permanent, but that which implies privation is transient.

14. We should notice, too, that some matter has a composition of form, for example bronze. For, although it is the matter with respect to the statue, the bronze itself is composed of matter and form. Therefore bronze is not called prime matter, even though it has matter. However, that matter which is understood without any form and privation, but rather is subject to form and privation, is called prime matter by reason of the fact that there is no other matter before it. This is also called *hyle*, [which means chaos or confusion in Greek]. Also, because all knowledge and every definition comes by way of the form, prime matter cannot be defined or known in itself but only through the composite; consequently it might be said that that is prime matter which is related to all forms and privations as bronze is to the statue and the shapeless; and this is called first *simpliciter*. A thing can also be called prime matter with respect to some genus, as water with respect to aqueous solutions; this, however, is not first *simpliciter* because it is composed of matter and form. Hence it has a prior matter.

15. Note, also, that prime matter, and likewise form, is neither generated nor corrupted, because every generation goes from something to something. But that from which generation takes place is matter, and that in which generation terminates is form. Therefore, if matter and form were generated, there would be a matter of matter and a form of form, and so on *ad infinitum*. Hence, properly speaking, there is generation only of the composite.

16. Again, notice that prime matter is said to be numerically one in all things. But

to be numerically one can be said in two ways: that which has a determined numerically one form, as Socrates; prime matter is not said to be numerically one in this way, since it does not have in itself a form. Also, something is said to be numerically one because it is without the dispositions which would cause it to differ numerically; prime matter is said to be numerically one in this way, because it is understood without all the dispositions which would cause it to differ numerically.

17. Notice, likewise, that, although prime matter does not have in its definition any form or privation, for example neither shaped nor shapeless is in the definition of bronze, nevertheless, matter is never completely without form and privation, because it is sometimes under one form and sometimes under another. Moreover, it can never exist by itself; because, since it does not have any form in its definition, it cannot exist in act, since existence in act is only from the form. Rather it exists only in potency. Therefore whatever exists in act cannot be called prime matter.

18. From this it is plain, therefore, that there are three principles of nature: matter, form and privation. But these are not sufficient for generation. What is in potency cannot reduce itself to act; for example, the bronze which is in potency to being a statue cannot cause itself to be a statue, rather it needs an **agent** in order that the form of the statue might pass from potency to act. Neither can the form draw itself from potency to act. I mean the form of the thing generated which we say is the term of generation, because the form exists only in that which has been made to be. However, what is made is in the state of becoming as long as the thing is coming to be. Therefore it is necessary that besides the matter and form there be some principle which acts. This is called the efficient, moving or agent cause, or that whence the principle of motion is. Also, because, as Aristotle says in the second book of the *Metaphysics*, everything which acts acts only by intending something, it is necessary that there be some fourth thing, namely, that which is intended by the agent; and this is called the end.

19. Again, we should notice that, although every agent, both natural and voluntary, intends an **end**, still it does not follow that every agent knows the end or deliberates about the end. To know the end is necessary in those whose actions are not determined, but which may act for opposed ends as, for example, **voluntary** agents. Therefore it is necessary that these know the end by which they determine their actions. But in natural agents the actions are **determined**, hence it is not necessary to choose those things which are for the end. Avicenna gives the following example. A harpist does not have to deliberate about the notes in any particular chord, since these are already determined for him; otherwise there would be a delay between the notes which would cause discord. However, it seems more reasonable to attribute deliberation to a voluntary agent

than to a natural agent. Thus it is plain, by reasoning *a maiori*, that, if a voluntary agent, for whom deliberation is more proper, sometimes does not deliberate, therefore neither does the natural agent. Therefore it is possible for the natural agent to intend the end without deliberation; and to intend this is nothing else than to have a natural inclination to something.

20. From the above it is plain that there are four causes: material, efficient, formal and final. But, although **principle** and **cause** are used convertibly, as is said in the fifth book of the *Metaphysics*, still, in the *Physics*, Aristotle gives four causes and three principles; because he takes as causes both what is extrinsic and what is intrinsic. Matter and form are said to be intrinsic to the thing because they are parts constituting the thing; the efficient and final causes are said to be extrinsic because they are outside the thing. But he takes as principles only the intrinsic causes; privation, however, is not listed among the causes because it is a principle *per accidens*, as was said.

21. When we say that there are four causes we mean the *per se* causes, to which all the *per accidens* causes are reduced, because everything which is *per accidens* is reduced to that which is *per se*.

22. And, although Aristotle calls intrinsic causes **principles** in the first book of the *Physics*, still **principle** is applied properly to extrinsic causes, as is said in the eleventh book of the *Metaphysics*; **element** is used for those causes which are parts of the thing, namely for the intrinsic causes; **cause** is applied to both. Nevertheless, one is sometimes used for the other: Every cause can be called a **principle** and every principle a **cause**.

23. However, **cause** seems to add something to **principle** as commonly used, because that which is primary, whether the existence of a posterior follows from it or not, can be called a **principle**, for example the manufacturer is called the principle of the knife because the existence of the knife comes from his operation. But, when something is moved from whiteness to blackness, whiteness is said to be the principle of that motion; and universally, everything from which motion begins is called a **principle**. However, whiteness is not that from which the existence of blackness follows. But cause is said only of that primarily from which the existence of the posterior follows. Hence we say that a cause that from whose existence another follows. Therefore that primarily from which motion begins cannot really be called a **cause**, even though it may be called a **principle**. Because of this, privation is placed among the principles and not among the causes, because privation is that from which generation begins. But it can also he called a *per accidens* cause in so far as it is coincident with matter, as was said above.

24. **Element**, on the other hand, is applied properly only to the causes of which the thing is composed, which are properly the materials. Moreover, it is not said of just any material cause, but of that one of which a thing is primarily composed; for example we do not say that the members of the body are the **elements** of man, because the members also are composed of other things; rather, we say that earth and water are the **elements**, because these are not composed of other bodies, but natural bodies are primarily composed of them.

25. Hence Aristotle says, in the fifth book of the *Metaphysics*, that an element is that of which a thing is primarily composed, which is in that thing, and which is not divided by a form. The explanation of the first part of the definition, "that of which a thing is primarily composed", is plain from the preceding. The second part, "which is in that thing", differentiates it from that matter which is entirely corrupted by generation; for example bread is the matter of blood, but blood is generated only by the corruption of bread. Thus bread does not remain in blood; and therefore bread cannot be called an element of blood. But the elements must remain in some way, since they are not entirely corrupted, as is said in the book *On Generation*. The third part, "and which is not divided by a form", differentiates an element from those things which have parts diverse in form, i.e., in species, as the hand whose parts are flesh and bone which differ according to species. An element is not divided into parts diverse according to species, rather it is like water whose every part is water. For an element to exist, it need not be undivided by quantity, rather it is sufficient that it be undivided by form. Even if it is in no way divided, it is called an element, just as letters are the elements of words. This it is plain from what was said that **principle**, in some way, applies to more than does **cause**, and **cause** to more than does **element**. This is what the Commentator says in the fifth book of the *Metaphysics*.

26. Now that we have seen that there are four genera of causes, we must understand that it is not impossible that the same thing have many causes, for example the statue whose causes are both the bronze and the artist: the artist is the efficient cause while the bronze is the material cause. Nor is it impossible that the same thing be the cause of contraries; for example the captain is the cause of the safety of the ship and of its sinking. He is the cause of the latter by his absence and of the former by his presence.

27. Also, notice that it is possible that the same thing be a cause and the thing caused, with respect to the same thing, but in diverse ways; for example, walking is sometimes the cause of health, as the efficient cause, but health is the cause of the walking, as the end: Walking is sometimes on account of health. Also, the body is the matter of the soul, but the soul is the form of the body.

28. The efficient cause is called a cause with respect to the end, since the end is actual only by the operation of the agent. But the end is called the cause of the efficient cause, since the efficient cause does not operate except by the intention of the end. Hence the efficient cause is the cause of that which is the end, for example walking in order to be healthy. However, the efficient cause does not cause the end to be the end. Therefore it is not the cause of the causality of the end, i.e., it does not cause the end to be the final cause; for example the doctor causes health to actually exist, but he does not cause health to be the end

29. Also, the end is not the cause of that which is the efficient cause, but it is the cause of the efficient cause being an efficient cause; for example health does not cause the doctor to be a doctor I am speaking of the health which comes about by the doctor's activity but it causes the doctor to be an efficient cause. Therefore the end is the cause of the causality of the efficient cause, because it causes the efficient cause to be an efficient cause. Likewise, the end causes the matter to be the matter and the form to be the form, since matter receives the form only for the sake of the end and the form perfects the matter only through the end. Therefore we say that the end is the cause of causes, because it is the cause of the causality in all causes.

30. Also, we say that matter is the cause of the form, in so far as the form exists only in matter. Likewise, the form is the cause of the matter, in so far as matter has existence in act only through the form because matter and form are spoken of in relation to each other, as is said in the second book of the *Physics*. They are also spoken of in relation to the composite, as the part to the whole and as the simple to the composed.

31. But, because every cause, as cause, is naturally **prior** to that which it causes, notice that we say a thing is prior in two ways, as Aristotle says in book XVI of the *History of Animals*. Because of this diversity, we can call something prior and posterior with respect to the same thing, both the cause and the thing caused. We say that one thing is prior to another from the point of view of generation and time, and likewise from the point of view of substance and completeness. Since the operation of nature proceeds from the imperfect to the perfect and from the incomplete to the complete, the imperfect is prior to the perfect namely, from the point of view of generation and time, but the perfect prior to the imperfect from the point of view of substance. For example we can say that the man is before the boy according to substance and completeness, but the boy is before the man according to generation and time. But, although in generable things the imperfect is prior to the perfect and potency to act when we consider that in one and the same thing the imperfect is prior to the perfect and potency to act, still, simply speaking, the act and the perfect must be prior, because it is what is in act that reduces potency to act and it is the perfect that perfects the

imperfect.

32. Matter is prior to form from the point of view of generation and time because that to which something comes is prior to that which comes to it. But form is prior to matter from the point of view of substance and completeness, because matter has completed existence only through the form. Likewise, the efficient cause is prior to the end from the point of view of generation and time, since the motion to the end comes from the efficient cause. But the end is prior to the efficient cause, in so far as it is the efficient cause, from the point of view of substance and completeness, since the action of the efficient cause is completed only through the end. Therefore these two causes, the material and the efficient, are prior by way of generation, but the form and the end are prior by way of perfection.

33. It must be noted that there are two kinds of necessity: absolute and conditional. **Absolute necessity** is that which proceeds from the causes prior by way of generation: the material and the efficient causes. An example of this is the necessity of death which comes from the matter, namely the disposition of the composing contraries. This is called absolute because it does not have an impediment. It is also called the necessity of matter. **Conditional necessity**, on the other hand, proceeds from causes posterior in generation, namely, the form and the end. For example we say that it is necessary that there be conception if a man is to be generated. This is called conditional because it is not necessary simply that this woman conceive, but only conditionally, namely, if a man is to be generated. This is called the necessity of the end.

34. Notice, also, that three causes can coincide in one thing, namely, the form, the end and the efficient cause, as is plain in the generation of fire. Fire generates fire; therefore fire is the efficient cause in so far as it generates; also, fire is the formal cause in so far as it causes to exist actually that which before was in potency; again, it is the end in so far as the operations of the agent are terminated in it and in so far as it is intended by the agent.

35. But the end is twofold: the end of generation and the end of the thing generated, as is plain in the generation of a knife. The form of the knife is the end of generation; but cutting, which is the operation of the knife, is the end of the thing generated, namely, of the knife. Moreover the end of generation sometimes is coincident with the two aforementioned causes, namely, when generation takes place from what is similar in species, as when man generates man and the olive, an olive. But this cannot be understood of the end of the thing generated.

36. Notice, nevertheless, that the end coincides with the form in something which is numerically the same, because that which is the form of the thing generated and that which is the end of generation are the same numerically. But it does not coincide with the efficient cause in a thing numerically the same, but in a thing specifically the same, because it is impossible that the maker and the thing made be numerically the same, but they can be specifically the same. Thus, when man generates man, the man generating and the one generated are numerically diverse, but they are specifically the same. However, matter does not coincide with the others. This is because matter, by the fact that it is being in potency, has the nature of something imperfect; but the other causes, since they are in act, have the nature of something perfect. However, the perfect and the imperfect do not coincide in the same thing.

37. Therefore, now that we have seen that there are four causes, the efficient, formal, material and final, we must note that any of these causes can be spoken of in many ways. We call one thing a prior cause and another a posterior cause; for example we say that art and the doctor are the cause of health, but art is a prior cause and the doctor is a posterior cause; and it is similar in the formal cause and in the other causes. Notice, also that we must always bring the question back to the first cause. For example, if it be asked: "Why is this man healthy?", we would answer: "Because the doctor has healed him." Likewise, if it be asked: "Why did the doctor heal him?", we would say: "Because of the art of healing which the doctor has."

38. Notice, also, that the proximate cause is the same as the posterior cause and that the remote cause is the same as the prior cause. Hence these two divisions of causes into prior and posterior, remote and proximate signify the same thing. Moreover, it must be observed that that which is more universal is always called the remote cause, but that which is more particular is called the proximate cause. For example we say that the proximate form of man is his definition, namely, rational animal; but animal is more remote and substance is still more remote. All superiors are forms of the inferiors. Again, the proximate matter of the statue is bronze, but the remote matter is metal, and the still more remote is body.

39. Further, there is one cause which is a *per se* cause, another which is *per accidens*. A *per se* cause is said of one which is the cause of something as such, for example the builder is the cause of the house and the wood is the matter of the bench. A *per accidens* cause is said of one which happens to a *per se* cause. For example we say that the grammarian builds; the grammarian is called the cause of the building *per accidens*, not in so far as he is a grammarian, but in so far as it happens to the builder that he is a grammarian; and it is similar in other causes.

40. Likewise, some causes are simple, others are composed. A cause is simple when that alone is said to be the cause which is the *per se* cause, or that alone which is the *per accidens* cause; as if we were to say that the builder is the cause of the house and likewise if we were to say that the doctor is the cause of the house. A cause is composed when both are said to be the cause, as if we were to say that the medical builder is the cause of the house.

41. According to the explanation of Ibn-Sînâ, that can be called a simple cause also which is a cause without the addition of another; for example bronze is the cause of the statue without the addition of another matter because the statue is made of bronze; and we say that the doctor causes health or that fire heats. But a cause is composed when many things must come together in order that there be a cause; for example not one man, but many are the cause of the motion of a ship; and not one stone, but many are the cause of a house.

42. Again, some causes are in act, others are in potency. A cause in act is one which causes a thing in act, as the builder while he is building or the bronze when a statue is made of it. A cause in potency is one which, although it does not cause a thing in act, can, nevertheless, cause it; as a builder when he is not building.

43. Note that, in speaking of causes in act it is necessary that the cause and the thing caused exist at the same time, so that if one exists the other does also. If there is a builder in act, it is necessary that he be building and, if there is building in act, it is necessary that there be a builder in act. But this is not necessary in causes which are only in potency.

44. Moreover, it should be noted that the universal cause is compared to the universal thing that is caused and the singular cause is compared to the singular thing that is caused, for example we say that a builder is the cause of a house and that this builder is the cause of this house.

45. Also, notice that, when we speak of intrinsic principles, namely, matter and form, according to the agreement and difference of things that are from principles and according to the agreement and difference of principles, we find that some are numerically the same, as are Socrates and this man in the Socrates now pointed out; others are numerically diverse and specifically the same, as Socrates and Plato who, although they differ numerically, have the same human species; others differ specifically but are generically the same, as man and ass have the same genus animal; others are generically diverse and are only analogically the same, as substance and quantity which have no common genus and are only analogically the same, because they are the same only in so far as

they are beings. "Being", however, is not a genus because it is not predicated univocally, but only analogically.

46. In order to understand this last we must notice something is predicated of many things in three ways: univocally, equivocally and analogically. Something is predicated **univocally** according to the same name and the same nature, i.e., definition, as animal is predicated of man and of ass, because each is called animal and each is a sensible, animated substance, which is the definition of animal. That is predicated **equivocally** which is predicated of some things according to the same name but according to a different nature, as dog is said of the thing that barks and of the star in the heavens, which two agree in the name but not in the definition or in signification, because that which is signified by the name is the definition, as is said in the fourth book of the *Metaphysics*. That is said to be predicated **analogically** which is predicated of many whose natures are diverse but which are attributed to one same thing, as health is said of the animal body, or urine and of food, but it does not signify entirely the same thing in all three; it is said of urine as a sign of health, of body as of a subject and of food as of a cause. But all these natures are attributed to one end, namely to health.

47. Sometimes those things which agree according to analogy, i.e., in proportion, comparison or agreement, are attributed to one end, as was plain in the preceding example of health. Sometimes they are attributed to one agent, as medical is said of one who acts with art, of one who acts without art, as a midwife, and even of the instruments; but it is said of all by attribution to one agent which is medicine. Sometimes it is said by attribution to one subject, as "being" is said of substance, quantity, quality and the other predicaments, because it is not entirely for the same reason that substance is being, and quantity and the others. Rather, all are called being in so far as they are attributed to substance which is the subject of the others.

48. Therefore being is said primarily of substance and secondarily of the others. Therefore "being" is not a genus of substance and quantity because no genus is predicated of its species according to prior and posterior; rather, "being" is predicated analogically. This is what we mean when we say that substance and quantity differ generically but are the same analogically.

49. Therefore the form and matter of those things which are numerically the same are themselves likewise numerically the same, as are the form and matter of Tullius and Cicero. The matter and form of those things which are specifically the same and numerically diverse are not the same numerically, but specifically, as the matter and form of Socrates and Plato. Likewise, the matter and form of those things which are generically the same, as the soul and body of an ass and

a horse differ specifically but are the same generically; likewise, the principles of those things which agree only analogically or proportionally are the same only analogically or proportionally, because matter, form and privation or potency and act are the principles of substance and of the other genera. However, the matter, form and privation of substance and of quantity differ generically, but they agree according to proportion only, in so far as the matter of substance is to substance, in the nature of matter, as the matter of quantity is to quantity; still, just as substance is the cause of the others, so the principles of substance are the principles of all the others.

OTHER STATEMENTS FOR COMPARISON

Herbert L. Samuel, *Essays in physics*:

The nature of the problem has been clearly and briefly stated by Professor Henry Semant in his *Introduction to Atomic Physics*. He says: "The results of the experiments on the Compton effect leave no doubt that, in its interaction with matter, radiant energy behaves as though it were composed of particles. A similar behaviour was observed in the photo-electric effect. It will be shown later that in the processes of emission and absorption light behaves as though it consists of corpuscles. But the phenomena of interference and diffraction can be explained only on the hypothesis that radiant energy is propagated as a wave motion. We are thus led to the conclusion that radiant energy exhibits a dual character, that of a wave and that of a corpuscle." Semat also quotes L. de Broglie, who, he says, was led by considerations based upon the special theory of relativity and upon the quantum theory, to advance the hypothesis that "the dual character, wave and particle, should not be confined to radiation alone, but should also be exhibited by all the fundamental entities of physics. On this hypothesis, electrons, protons, atoms and molecules should have some type of wave motion associated with them." He adds that "results of experiments confirm de Broglie's hypothesis that there is a wave motion associated with every moving electron." Schrödinger says: "A vast amount of experimental evidence clinches the conviction that wave characteristics and particle characteristics are never encountered singly, but always in union; they form different aspects of the same phenomenon, and indeed of all physical phenomena." Richtmeyer and Kennard say that "Even molecules should exhibit wave properties under suitable conditions, according to the new theory. This, too, has been verified by experiment."

The conception of a single entity with a dual character, at once wave and particle, is hard to understand. It is not made the easier by the suggestion, usually advanced in this connection, that these are two "aspects" of the same

phenomenon. What is meant by the word aspects?

John of St. Thomas, *Natural philosophy*

Now that there is indeed an entity [primary matter] of such a potential and unformed character Aristotle deduced from two principles: first, from substantial generation itself, secondly from the fact that naturally nothing comes from nothing. And this second point is deduced from the first because if from nothing something would come to be, so that the whole substance of a thing would come from nothing, by this very fact there would not be generation but creation, and corruption would be annihilation. Hence determinate dispositions would not be required for determinate generations, but it would be possible for a stone or a horse or any other thing to come to be in the same way, because if it comes from nothing there is no point to the dispositions which make it determined more to one thing rather than another. However, if it comes to be from something and what comes to be is a substance, from the fact that the generation is substantial, it necessarily presupposes some subject capable of a new substantial existence and losing the existence which it had before because it is corrupted. Neither of these therefore it has of itself and consequently it is in potency to both of them.

Alfred North Whitehead, *Process and reality*

[The following passage raises the question of validity of causality, really a metaphysical problem, but to be noted now and considered later in metaphysics:] Let us now dismiss physiology and turn to the private experience of the blinking man. The sequence of percepts, in the mode of presentational immediacy, are flash of light, feeling of eye-closure, instant of darkness. The three are practically simultaneous; though the flash maintains its priority over the other two, and these two latter percepts are indistinguishable as to priority. According to the philosophy of organism, the man also experiences another percept in the mode of causal efficacy. He feels that the experiences of the eye in the matter of the flash are causal of the blink. The man himself will have no doubt of it. In fact, it is the feeling of causality which enables the man to distinguish the priority of the flash; and the inversion of the argument, whereby the temporal sequence "flash to blink" is made the premise for the "causality" belief, has its origin in pure theory. The man will explain his experience by saying, "The flash made me blink," and if his statement be doubted, he will reply, "I know it, because I felt it."

The philosophy of organism accepts the man's statement, that the flash made him blink. But David Hume intervenes with another explanation. He first points out that in the mode of presentational immediacy there is no percept of the flash making the man blink. In this mode there are merely the two perceptsthe flash

and the blinkcombining the two latter of the three percepts under the one term "blink". Hume refuses to admit the man's protestation, that the compulsion to blink is just what he did feel. The refusal is based on the dogma, that all percepts are in the mode of presentational immediacya dogma not to be upset by a mere appeal to direct experience. Besides Hume has another interpretation of the man's experience: what the man really felt was his habit of blinking after flashes. The word "association" explains it all, according to Hume. But how can a "habit" be felt, when a "cause" cannot be felt? Is there any presentational immediacy in the feeling of a "habit"? Hume by a sleight of hand confuses a "habit of feeling blinks after flashes" with a "feeling of the habit of feeling blinks after flashes".